Meyer's reaction is at once apparent. To prove the fact Dr. Wislicenus shows that the silver salt of hyponitrous acid may actually be obtained from the solution at a certain stage of the reaction, and the experiment forms the best method yet described of demonstrating the formation and properties of hyponitrous acid. There is always a considerable amount of hyponitrous acid present in the slowly-effervescing liquid obtained by mixing solutions of hydroxylamine sulphate and sodium nitrite at the ordinary temperature. Much more, however, is present for a few minutes when the liquid is warmed to 50–60°. At this temperature the decomposition is sufficiently rapid to cause somewhat energetic effervescence, but by the immediate addition of a solution of silver nitrate the greater portion of the hyponitrous acid can be fixed and precipitated in the form of the bright yellow stable silver salt, $Ag_2N_2O_2$. The yield of the finely divided precipitate is about ten grams for every hundred grams of hydroxylamine.

When it is desired to demonstrate this mode of formation of hyponitrous acid upon the lecture table, solutions of about three grams of hydroxylamine sulphate and the equivalent quantity of sodium nitrite are previously and separately prepared. The total amount of solvent water should not exceed two hundred cubic centimetres. When the time arrives to perform the experiment the two solutions are mixed and a little of the resulting liquid immediately decanted into a test glass, silver nitrate solution added, and the fact pointed out that the resulting precipitate of nitrite and sulphate of silver is white. The vessel containing the main quantity of the liquid is then transferred to a water bath warmed to 50°, when a rapid evolution of gas at once commences. The issuing gas may rapidly be shown to answer to the properties of nitrous oxide by inserting a glowing splint, and almost immediately silver nitrate solution should be added to the liquid, when the beautiful bright yellow silver salt of hyponitrous acid is precipitated.

Notes from the Marine Biological Laboratory, Plymouth.—Last week's captures include the Polychæta *Hyalinœcia tubicola* and *Amblyosyllis* (*Gattiola*) *spectabilis*; the Mollusca *Ovula patula* and *Loligo media* (136 mm. in length of mantle!); the Decapod Crustacea *Nika edulis*, *Ebalia Pennantii* and *Cranchii*; and the Tunicata *Clavelina lepadiformis*, *Archidistoma aggregatum* and *Ferophora Listeri*. The "gelatinous alga" has now entirely replaced *Halosphæra viridis*, and both spherical and elongated forms are being taken in the townets in great profusion. A single specimen of the Cladoceran *Podon*, carrying embryos, has been taken for the first time this year. Among the many animals now breeding, the following have not previously been noticed: the Cephalopod *Loligo media*; the Leptostracan *Nebalia bipes*; the Schizopod *Macromysis flexuosa* (= *chamæleon*); the Macrura *Pandalus brevirostris* and *Hippolyte Cranchii*, and the Brachyuran *Porcellana longicornis*. The *Glaucothoë*-stage of *Pagurus* has also been taken.

The additions to the Zoological Society's Gardens during the past week include a Black-bellied Weaver Bird (*Euplectes afer*), Pin-tailed Whydah Bird (*Vidua principalis*), an Orange-cheeked Waxbill (*Estrelda melpoda*), two Common Waxbills (*Estrelda cinerea*) from West Africa, two Amaduvade Finches (*Estrelda amandava*), two Indian Silver-bills (*Munia malabarica*) from India, presented by Miss Herring; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mr. H. H. Forsayth; four Red-backed Buzzards (*Buteo erythronotus*) from the Falkland Islands, two presented by Dr. Dale, and two presented by Mr. Vere Packe; three Upland Geese (*Bernicla magellanica*) from Patagonia, presented by Sir Roger T. Goldsworthy; a Herring Gull (*Larus argentatus*) British, presented by Mr. Thomas Owen; an Alexandrine Parrakeet (*Palæornis alexandri*) from India, presented by Mr. S. Hulme; a Banded-tailed Tree Snake (*Ahætulla liocercus*), a — Snake (*Dipsas cenchoa*) from Trinidad, presented by Messrs. Mole and Urich; six Green Tree-frogs (*Hyla arborea*) European, presented by the Rev. Clifford D. Fothergill; a Moorish Toad (*Bufo mauritanica*) from Tunis, a Banded-tailed Tree Snake (*Ahætulla liocercus*) from Trinidad, deposited; two Red Oven Birds (*Furnarius rufus*), a Melancholy Tyrant (*Tyranus melancholicus*) from the Argentine Republic, a white-eyebrowed Wood Swallow (*Artamus superciliosus*) from New South Wales, six Edible Frogs (*Rana esculenta*) European, purchased; a Gayal (*Bibos frontalis*, ♂) born in the Gardens.

## OUR ASTRONOMICAL COLUMN.

The Photographic Chart of the Heavens.—M. Lœwy in *Comptes Rendus* (No. 13) for March 27 adds a few more words with regard to the scheme which he has suggested for determining the coordinates of the centres of the clichés. Without such a method as his, or at any rate one that has for its object the same end (that is, of shortening the work), it seems that the work of determining the positions of the chief stars will extend over some period. With 22,054 plates covering 169 cm. and corresponding to a portion of the sky $4^\circ \cdot 7$ square, the average number of stars up to the eleventh magnitude is estimated as 250. Now it is not necessarily certain that on all of these plates there will be stars whose positions are accurately known, and further, even if accurate places had once been obtained, our knowledge of their proper motions is not considered advanced enough to apply them in such an instance as this. Only the two following ways, then, seem to be left:—(1) To observe afresh with our meridian circles as many (say six) stars as will appear on each cliche and deduce their positions (thus eliminating proper motion), or (2) to adopt a system of triangulation, assuming we know the places of some of the more important position stars. M. Lœwy's method is based on the latter, in which he groups the clichés together; for instance, the first grouping would contain as many as sixteen square degrees, but the second, third, &c., would cover just twice this number. With regard to "le problème du rattachement" he says, "Malgré tous les soins pris pour exécuter les photographies dans des conditions toujours semblables, il est impossible que les coordonnées mesurées sur deux clichés voisins soient immediatement et rigoureusement comparable. Chacun d'eux, en effet, représente la projection d'une portion de la sphère céleste sur un plan déterminé, et les plans de projection relatifs à deux plaques voisines sont inclinés l'un sur l'autre d'un certain angle. Les poses ont pu être effectuées à des époques très différentes; on ne saurait donc s'attendre à ce que la situation des plaques par rapport à l'axe de la lunette, l'orientation l'échelle des mesures soient identiques dans les deux cas. Par suite il est nécessaire de faire subir aux grandeurs mesurées certaines corrections, si l'on veut qu'elles constituent un système unique et homogène de coordonnées." In his first memoir M. Lœwy has already given the formulæ, &c., for reduction, and in the one to which we refer below he gives us an application of his method.

In *Comptes Rendus* for April 4 (No. 14) M. Lœwy states the results that he has obtained in applying his method of determining the coordinates of the stars on the clichés for the Photographic Chart. As it would be impossible to give an idea of this computation without entering into the subject at some length, it seems best that we should leave it quite alone and refer our readers to the journal itself, from which he will get full information. Suffice it for us to say that in the different methods of "raccordement" based on twenty-six well determined positions, the probable error of the equatorial coordinates amounts nearly to $\pm 0'' \cdot 1$, but "comme il faut encore admettre les erreurs réelles plus fortes qui les valeurs théoriques calculées, il devient evident que le degré d'exactitude obtenu, bien que suffisant, est loin d'être exagéré."

Catalogue of Southern Star Magnitudes.—In vol. xii. no. 1 of the *Memoirs of the American Academy of Arts and Sciences* will be found the results in catalogue form of Mr. Edwin Sawyer's determinations of the magnitudes of southern stars from 0° to −30° Declination to the 7th magnitude inclusive.

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The general plan was to observe every star three times, and out of the total number of stars in the catalogue (3415) 289 stars were observed less than this number of times, while 1048, 491, and 194 stars were observed four, five, and six times respectively, and the rest seven times or more. The various differences of brightness were estimated by Argelander's method of step-estimations, each sequence comprising ten, five, or twenty stars according to the number of stars in the vicinity observed. Commencing in the year 1882, Mr. Sawyer says that nearly half of the whole work was done in that time, an opera glass being extensively used for fainter sequences, such as those in which the stars were of the 6th or fainter magnitude a field glass was employed. During the years 1883 and 1885 the observations, as he tells us, were wholly discontinued, "owing to the injury to the eyes from the trying nature of the work." In the method of reduction the magnitudes were deduced by plotting out the sequences, graphically using the *Uranometria Argentina* magnitudes as ordinates, and the observed differences of brightness, expressed in steps, as abscissas. The arrangement of the catalogue itself is as follows:—The columns give successively the catalogue current number of the star, U.A. catalogue number, constellation, Right Ascensions and Declinations for mean equinox 1875·0, number of observations, mean magnitude deduced, U.A. magnitude, and the three last the separate dates of the observations and magnitudes.

Comparing the average differences between the magnitudes here assigned and those given by Gould, it is found that ± 0·088m. about represents it, while the average error of a single determination, assuring equal degree of precision and including besides accidental errors, the effect of systematic difference is given as ± 0·059m.

While the work was in hand eight variables were discovered, which were as follows:—U Ophiuchi (1881), U Ceti (1885), U Aquilæ and Y Sagittarii (1886), R Canis Majoris (1887), Y Ophiuchi and W Hydræ (1888), and (?) Leporis (1891), and in addition several large discordances were noticed in many values obtained (the catalogue number of these are here given), rendering these stars worthy of special attention. The volume concludes with notes, in which several suspicious cases of variables, &c., are recorded.

A New Table of Standard Wave-lengths.—Under this title Prof. H. A. Rowland contributes to *Astronomy and Astrophysics* for April (No. 114) the new measurements of several metallic lines to be used as standards. The actual measures were made by Mr. L. E. Jewell, the probable error of one setting amounting to 1 part of 5,000,000 of the wave-length, and the reductions of the reading by Prof. Rowland himself. The measurements were obtained with a new machine, supplied with a screw specially made after Prof. Rowland's process. The standard wave-length of D used was the mean of the determinations of Angström, Müller and Kempf, Kurlbaum, Pierce, and Bell, and was 5896·156, different weights being given to these separate values. This value was utilised in six different ways, and the resulting table of wave-lengths from 2100 to 7700 was obtained, the accuracy of which might, as he says, be estimated as follows:—"Distribute less than $\frac{1}{100}$ division of Angström properly throughout the table as a correction, and it will be perfect within the limits 2400 and 7000."

Meteor Showers.—Among the principal meteor showers for the current year, a list of which is given in the *Companion to the Observatory*, the following two occur this week, the former of which is described by Denning as "one of the most briliant showers." The radiant points are:—

| Date | Radiant | | Meteors |
|---|---|---|---|
| | α | δ | |
| April 20 ... | 270° | + 33° ... | Swift |
| ,, 25 ... | 272° | + 21° ... | Swift; short |

Wolsingham Observatory, Circular No. 35.—A plate taken with the Compton 8-inch photo-telescope, April 11, compared with a photo by Max Wolf, 1891, shows that the two stars

Es-Birm 545 18h. 28·9m. + 36° 55′ (1900)
,, 561 18h. 39·4m. 36° 52′ ,,

are var., the photo differences being approximately 9·1, 11·4; 8·8, 10·2.

## GEOGRAPHICAL NOTES.

Letters dated March 9 have been received from the Antarctic whaling vessels confirming and extending the brief telegraphic information already published. The ships did not proceed farther south than 67° latitude, and discovered no signs of the existence of the Greenland whale, although whales of several other species were common, and there were great numbers of grampuses. In default of whaling, the energy of the crews was devoted to sealing, and the four vessels secured between them about 16,000 skins and a full cargo of oil. The seals were of several varieties, but until the return of the ships their species cannot be determined, nor their commercial value known. The weather throughout the whole stay in Antarctic waters was severe, and the formation of ice compelled the vessels to return at an earlier date than was at first intended. Flat icebergs of enormous size were seen, one being reported as fifty miles in length. The facilities afforded for scientific work were disappointing.

The Delcommune expedition (p. 474) has returned to Europe, and M. Delcommune was received with great enthusiasm in Brussels. The expedition, together with the others sent out by the Katanga Company, has to a large extent completed the work of Livingstone and his successors in the Congo Basin, and in the main confirms the accepted geography of the region. One point of some interest which has been established is that the Lake Lanji, marked from Arab reports at the junction of the Lukuga and the Lualaba, has no existence.

The new number of *Petermann's Mitteilungen* contains a short paper by Prof. Krümmel on recent Russian oceanographical work in the north Pacific. This is accompanied by a map of the salinity of the surface water, which extends, and in a general way confirms, Mr. Buchanan's map founded on the *Challenger* work. The centre of maximum salinity lies between 20° and 30° N., and has its centre about 170° W. A tongue of considerably fresher water stretches nearly across the ocean, about 10° N. and sweeps round the coasts of America and Asia. The diminution of salinity northward is very interesting, the curves of equal salinity sweeping through Bering Sea without regard to the line of Aleutian Islands, thus showing that so far as regards surface water, Bering Sea is simply part of the Pacific ocean, standing in very marked contrast to the Sea of Okhotsk, a fact of some interest during the present international controversy.

Mr. T. H. Hatton-Richards read a paper on British New Guinea at the last meeting of the Royal Colonial Institute. While giving an account of the climate discouraging to would-be white settlers, Mr. Richards describes the native Papuans from personal experience as a fine race, possessing a keen sense of justice, and most laborious and successful as agriculturists.

## RECENT INNOVATIONS IN VECTOR THEORY.[1]

Of late years there has arisen a clique of vector analysts who refuse to admit the quaternion to the glorious company of vectors. Their high priest is Prof. Willard Gibbs. His reasons for developing a vector analysis devoid of the quaternion are given with tolerable fullness in Nature, vol. xliii. p. 511. His own vector analysis is presented in a pamphlet, "Elements of Vector Analysis, arranged for the Use of Students in Physics, not Published" (1881–84). Mr. Oliver Heaviside, in a series of papers published recently in the *Electrician* and in an elaborate memoir in the *Philosophical Transactions*, supports some of Gibbs's contentions and cannot say hard enough things about the quaternion as a quantity which no physicist wants. Prof. Macfarlane, of Texas University, has added to the literature of the subject, and without altogether agreeing with Gibbs takes umbrage at a most fundamental principle of quaternions and developes a pseudo-quaternionic system of vector algebra which is non-associative in its products!

Between the years 1846–52, just at the time when Hamilton was developing the quaternion calculus, a series of papers was published by the Rev. M. O'Brien, Professor in King's College, London. The system developed by O'Brien is essentially that

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[1] Abstract of a paper by Prof. C. G. Knott, read before the Royal Society of Edinburgh, on Monday, December 19, 1892.

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